Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/845
JAPAN
February 1964
Submitted in: ENGLISH and FRENCH

Confidential until official release during Conference

Abstract

SOME ASPECTS OF REACTOR ANALYSIS

Part I. Remarks on the Theoretical Treatment of a Homogeneous System
Jitsuya HIROTA[1] and Satoru KATSURAGI[1]

Part II. An Advancement on the Integral Transport Theory for the Heterogeneous System
Yuzo FUKAI[2], Ichiro KOMATSU[2], Hiroshi TAKAHASHI[1] and Takashi NAKAYAMA[1]

Part I. A series of critical experiments and theoretical analysis have been made on two-region systems in which a heavy water solution of uranylsulfate (^{235}U enrichment about 20 per cent) is surrounded by heavy water, poisoned with boron or mixed with thorium oxide.

In the analysis of these systems, leakage of fast neutrons from the core and competition of the leakage with resonance absorption in the core are important. To take these effects into consideration, it is required to adopt a multigroup model. For systems with a high fuel concentration, the spatial dependence of the spectrum becomes significant. The thermal flux distribution varies rather sensitively with the effective cross section adopted in calculation. Each region should be divided into many subregions with different effective cross sections.

The effective multiplication factor is reduced by the rigorous treatment of the fast neutron leakage from the core, and is increased by using space-dependent effective cross sections. Any disagreement in the effective multiplication factor found between the theoretical and experimental values might be attributed to uncertainties in the resonance integral of ^{235}U. These analyses suggest that the accepted value of $\nu I_f - L_a$ is about 50 b too large. The effective multiplication factors are also affected to some extent by the resonance integral of thorium.

1) Japan Atomic Energy Research Institute, Tokai-mura, Ibaraki-ken, Japan.
2) Nippon Atomic Industry Group Co., Chiyoda-ku, Tokyo, Japan

Part II. The integral neutron transport theory has been accorded more importance in calculations of heterogeneous reactors than the differential theory, for its applicability to more complex systems.

The effect of anisotropic scattering by the moderator atom on the flux ratio of the moderator to the fuel in the slab lattice is intensively studied, and the propriety of approximation by replacing the total cross section of the moderator by the transport cross section is investigated.

Exact expressions of first flight collision probability in the hexagonal and square lattices are derived in order to remove the error introduced by the cylindrical cell approximation. Although it has hitherto been believed to be difficult to obtain by the integral transport theory the collision probability in these lattices with anisotropic scattering, formulation of the probability is succeeded in the case of a cylindricalized lattice.

The factorization method in calculations of the thermal neutron spectrum is extended to the case of the integral transport equation, and the calculation method of fast fission effect without iteration is discussed in comparison with the Monte Carlo method.